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COPPER ALLOY EXCELLENT IN ELECTRIC -DISCHARGE WEAR RESISTANCE

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EC Classification:	
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Abstract

PROBLEM TO BE SOLVED: To obtain a copper alloy excellent in electric-discharge wear resistance, used for parts causing electric-discharge wear, such as motor commutator and various contacts.
SOLUTION: This copper alloy has a composition consisting of, by weight, 0.1-1.0% Si and the balance copper with inevitable impurities and further containing, if necessary, 0.01-6.0%, in total, of at least one or more kinds among 0.01-1.0% Mg, 0.01-1.0% Al, 0.01-1.0% Ti, 0.01-1.5% Cr, 0.01-1.0% Mn, 0.01-3.0% Fe, 0.01-3.0% Co, 0.01-4.0% Ni, 0.01-5.0% Zn, 0.01-1.0% Zr, 0.01-1.0% Ag, and 0.01-2.0% Sn.

TOP

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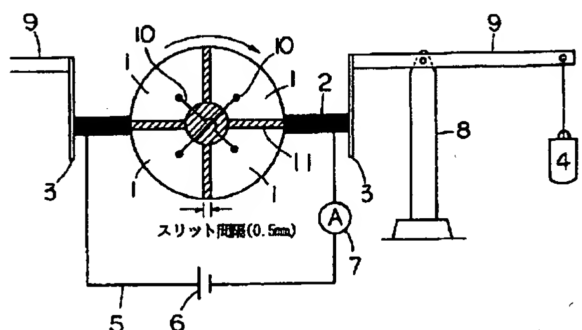
(54)【発明の名称】　耐放電摩耗性が優れる銅合金

(57)【要約】
【課題】　耐放電摩耗性に優れた銅合金を得る。
【解決手段】　Ｓｉ：０．１～１．０ｗｔ％を含有し、さらに必要に応じてＭｇ：０．０１～１．０ｗｔ％、Ａｌ：０．０１～１．０ｗｔ％、Ｔｉ：０．０１～１．０ｗｔ％、Ｃｒ：０．０１～１．５ｗｔ％、Ｍｎ：０．０１～１．０ｗｔ％、Ｆｅ：０．０１～３．０ｗｔ％、Ｃｏ：０．０１～３．０ｗｔ％、Ｎｉ：０．０１～４．０ｗｔ％、Ｚｎ：０．０１～５．０ｗｔ％、Ｚｒ：０．０１～１．０ｗｔ％、Ａｇ：０．０１～１．０ｗｔ％、Ｓｎ：０．０１～２．０ｗｔ％のうち少なくとも１種類以上を総量で０．０１～６．０ｗｔ％含有し、残部が銅及び不可避不純物からなる銅合金。



【特許請求の範囲】

【請求項1】　Ｓｉ：０．１〜１．０ｗｔ％を含み、残部が銅及び不可避不純物からなることを特徴とする耐放電摩耗性が優れる銅合金。

【請求項2】　Ｓｉ：０．１〜１．０ｗｔ％を含有し、さらにＭｇ：０．０１〜１．０ｗｔ％、Ａｌ：０．０１〜１．０ｗｔ％、Ｔｉ：０．０１〜１．０ｗｔ％、Ｃｒ：０．０１〜１．５ｗｔ％、Ｍｎ：０．０１〜１．０ｗｔ％、Ｆｅ：０．０１〜３．０ｗｔ％、Ｃｏ：０．０１〜３．０ｗｔ％、Ｎｉ：０．０１〜４．０ｗｔ％、Ｚｎ：０．０１〜５．０ｗｔ％、Ｚｒ：０．０１〜１．０ｗｔ％、Ａｇ：０．０１〜１．０ｗｔ％、Ｓｎ：０．０１〜２．０ｗｔ％のうち少なくとも１種類以上を総量で０．０１〜６．０ｗｔ％含有し、残部が銅及び不可避不純物からなることを特徴とする耐放電摩耗性が優れる銅合金。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、モーターコンミュテータ（整流子）又は各種接点など放電摩耗の起こる部品に使用される銅合金に関するものである。

【０００２】

【従来の技術】従来、モーターコンミュテータ又は接点用材料として、導電率の高い無酸素銅、タフピッチ銅、りん脱酸銅、銀入り銅などが用いられている。これは、導電率の高い材料は接点でのジュール熱の発生が少なく、抜熱効果も高いため、接点の高温化が抑制でき、放電量が少なくなることによる。しかし、自動車などに用いられるコンミュテータや各種接点部品は、信頼性向上の要求から、さらなる高寿命が求められている。そのため、上記純銅系材料に代わる耐放電摩耗性が優れる銅合金の開発が必要となってきた。

【０００３】

【発明が解決しようとする課題】本発明は上記従来技術の問題点に鑑みてなされたものであり、耐放電摩耗性が優れる銅合金を提供することを目的とする。

【０００４】

【課題を解決するための手段】本発明に関わる耐放電摩耗性が優れる銅合金は、Ｓｉ：０．１〜１．０ｗｔ％を含み、残部が銅及び不可避不純物からなることと特徴とし、さらに必要に応じてＭｇ：０．０１〜１．０ｗｔ％、Ａｌ：０．０１〜１．０ｗｔ％、Ｔｉ：０．０１〜１．０ｗｔ％、Ｃｒ：０．０１〜１．５ｗｔ％、Ｍｎ：０．０１〜１．０ｗｔ％、Ｆｅ：０．０１〜３．０ｗｔ％、Ｃｏ：０．０１〜３．０ｗｔ％、Ｎｉ：０．０１〜４．０ｗｔ％、Ｚｎ：０．０１〜５．０ｗｔ％、Ｚｒ：０．０１〜１．０ｗｔ％、Ａｇ：０．０１〜１．０ｗｔ％、Ｓｎ：０．０１〜２．０ｗｔ％のうち少なくとも１種類以上を総量で０．０１〜６．０ｗｔ％含有する。

【０００５】以下、本発明に係る銅合金の各成分の添加理由及び組成限定理由について説明する。

Ｓｉ：０．１〜１．０ｗｔ％

Ｓｉは、本発明合金において必須の成分である。Ｓｉの酸化物（SiO_2）は生成自由エネルギーが小さく、かつ融点が高い（１７２０℃）のため、高温で安定であり、さらに、高温での電気抵抗が高い（１２００℃で３×10^2Ω・ｍ）。一方、放電は通電によって発熱した接点がＯＦＦになる過程で、材料表面からの電子放射と金属蒸気との相互作用で起こるものと考えられる。Ｓｉを含有する合金は、この過程において、材料表面に酸化膜を生成しやすい。しかもこの酸化膜は高温で安定でかつ電気抵抗が高いため、放電をすみやかに消滅させる役割を担うものである。本発明者はコンミュテータや各種接点部品等、放電摩耗の起こる部品には、導電率以外にこの効果が重要であることを見い出し、本発明をなし得たものである。そして、Ｓｉ含有量が０．１ｗｔ％未満ではこの効果は小さく、１．０ｗｔ％を超えて含有しても、この効果が飽和するとともに導電率の低下、熱間加工性の劣化を招く。したがって、Ｓｉ含有量は０．１〜１．０ｗｔ％とする。特に好ましい範囲は０．２〜０．８ｗｔ％である。

【０００６】Ｍｇ、Ａｌ、Ｍｎ、Ａｇ：各々０．０１〜１．０ｗｔ％、Ｚｎ：０．０１〜５．０ｗｔ％、Ｓｎ：０．０１〜２．０ｗｔ％

これらの元素はＣｕ−Ｓｉ合金をさらに固溶強化する目的で添加されるものである。接点材で最も重要な特性は耐放電摩耗性であるが、接点ＯＮ−ＯＦＦの繰り返しによる機械摩耗量が小さいことも要求される。したがって、耐摩耗性を向上させるために適宜添加されるものである。各々の含有量が０．０１ｗｔ％未満ではこの効果は小さい。また、各々の元素の上限値を超えて含有しても効果が飽和するとともに、Ａｇを除いて導電率の低下が著しくなる。なお、Ａｇは高価であり、経済的制約も考慮して上記の上限値を設定した。各々の好ましい含有量は、Ｍｇ、Ａｌ、Ｍｎ、Ａｇが各々０．０１〜０．６ｗｔ％、Ｚｎが０．０３〜３．５ｗｔ％、Ｓｎが０．１〜１．５ｗｔ％である。

【０００７】Ｔｉ、Ｚｒ：各々０．０１〜１．０ｗｔ％

Ｃｒ：０．０１〜１．５ｗｔ％

Ｆｅ、Ｃｏ：各々０．０１〜３．０ｗｔ％

Ｎｉ：０．０１〜４．０ｗｔ％

これらの元素は、Ｃｕ−Ｓｉ合金に添加されることによって、Ｓｉと化合物を形成し析出強化する。先に挙げた元素と同様に耐摩耗性を向上させる目的で適宜添加されるものである。各々の含有量が０．０１ｗｔ％未満では、この効果は小さい。また、各々の元素の上限を超えて含有しても効果が飽和するとともに導電率の低下が著しくなる。したがって、上記の上下限値を設定した。各々の好ましい含有量は、Ｔｉが０．０５〜１．０ｗｔ％、Ｚｒが０．０１〜０．３ｗｔ％、Ｃｒが０．０５〜

１．０ｗｔ％、Ｆｅ、Ｃｏが各々０．１～２．５ｗｔ％、Ｎｉが０．３～４ｗｔ％である。

【０００８】なお、上記副成分は２種以上複合添加することができるが、その総量が０．０１ｗｔ％未満では、強度向上の効果は小さく、６．０ｗｔ％を超えて含有すると導電率の低下が著しくなる。したがって、複合添加する場合の総量は０．０１～６．０ｗｔ％とした。好ましくは０．５～３％である。好ましい副成分の組み合せとしては、Ｔｉ（又はＺｒ、Ｃｒ、Ｆｅ、Ｃｏ、Ｎｉ）とＭｇ（又はＡｌ、Ｍｎ、Ａｇ、Ｚｎ、Ｓｎ）の組み合せが挙げられる。

【０００９】

【実施例】以下、本発明の実施例についてその比較例と比較して説明する。クリプトル炉を用いて、表１に示す組成の銅合金を、大気中で木炭被覆下にて溶解及び鋳造し、厚さ５０ｍｍ、幅７５ｍｍ、長さ１８０ｍｍの鋳塊を得た。この鋳塊の表面と裏面を切削した後、９５０℃の温度で厚さ１５ｍｍまで熱間圧延した。次に、グラインダーにより酸化スケールを除去した後、冷間圧延及び５００℃の温度で４時間の焼鈍を行った後、最後の冷間圧延で４．０ｍｍの厚さとした。表１に本発明に係る銅合金及び比較合金のビッカース硬さと導電率を併記する。

【００１０】

【表１】

		化学成分(wt%)			導電率 (%IACS)	ビッカース硬さ (Hv)	摩耗量 (mg)
		Ｃｕ	Ｓｉ	副成分			
本発明合金	１	残部	0.19	－	57	106	430
	２	〃	0.52	－	32	117	360
	３	〃	0.91	－	22	129	460
	４	〃	0.48	Ｍｇ 0.34	26	155	370
	５	〃	0.53	Ａｌ 0.41	20	161	450
	６	〃	0.50	Ｍｎ 0.55	21	135	470
	７	〃	0.51	Ａｇ 0.10	31	124	310
	８	〃	0.47	Ｚｎ 2.31	30	127	340
	９	〃	0.52	Ｓｎ 1.28	21	172	420
	１０	〃	0.50	Ｔｉ 0.86	59	175	330
	１１	〃	0.53	Ｚｒ 0.21	38	145	340
	１２	〃	0.51	Ｃｒ 0.68	40	169	300
	１３	〃	0.52	Ｆｅ 1.49	42	158	320
	１４	〃	0.49	Ｃｏ 1.73	51	177	300
	１５	〃	0.50	Ｎｉ 2.25	55	183	280
	１６	〃	0.54	Ｎｉ 2.23 Ｚｎ 1.14	53	185	270
	１７	〃	0.70	Ｎｉ 3.2 Ｍｇ 0.01 Ｚｎ 0.2 Ｍｎ 0.03	45	210	245
比較合金	１８	〃	0.06	－	80	102	590
	１９	〃	1.13	－	18	133	560
	２０	タフピッチ銅(C1100)			100	98	780
	２１	Ａｇ入り銅(Cu-0.03Ag)			99	105	630

【００１１】次に本発明に係る銅合金及び比較合金の回転通電摩耗試験を行った。この試験は図１に示す回転通電摩耗試験機を用いて行った。図に示すごとく本発明合金ＮＯ．１～１７及び比較合金ＮＯ．１８～２１を、寸法４０ｍｍφ×４ｍｍｔの円板に加工し４等分した試験片１を絶縁体１１間に配設して４極の回転体とし、この回転体の両極面にはカーボンブラシ２、２の一端を接触させ他端に板バネ３、３の下部を連結した。この板バネ３、３の上端部にはそれぞれ加圧治具９、９の一端を連結し、その他端にはオモリ４をそれぞれ接続した。なお、１０は試験片１に連結された通電用リード線、５はカーボンブラシ２、２に連結される電線、６は直流電源、７は電流計、８は加圧治具の支柱である。

【００１２】上記の装置において、試験片１とカーボンブラシ２との接触圧力をオモリ４を用いて調整し、４３５ｇ／ｃｍ^{2}とした。この状態で試験片１に電流密度０．２Ａ／ｍｍ^{2}で通電し、周速度６．３ｍ／ｓｅｃ（回転数：３０００ｒｐｍ）でモータを回転させ通電回転摩耗試験を行なった。雰囲気は１５℃の大気中とし、４００時間後の試験片１の摩耗量を調査した。その結果を表１にあわせて示す。

【００１３】本発明合金はＳｉを０．１～１．０ｗｔ％の範囲で含有するとともに、良好な導電率と硬さを有しており、耐放電摩耗性が優れている。一方、比較合金Ｎｏ．１８はＳｉ含有量が少なく、耐放電摩耗性向上効果が小さい。さらにＮｏ．１９はＳｉが多すぎるため、導

電率が低下し摩耗量が大きくなっている。No．20、21はSiを含んでおらず、優れた導電率を有するものの、摩耗量が大きい。

【0014】

【発明の効果】以上説明したように、本発明の銅合金は、従来品に比較して導電率は低いものの耐放電摩耗性に優れており、例えばモーターコンミュテータ及び各種接点部品の寿命向上に寄与すること大である。

【図面の簡単な説明】

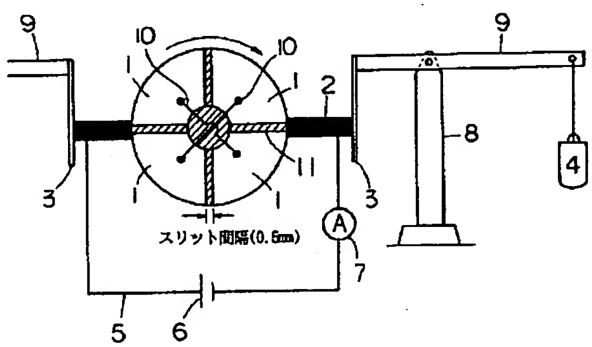
【図1】耐放電摩耗性を試験する回転通電摩耗試験機の側面図である。

【符号の説明】

1　試験片

2　カーボンブラシ

【図1】



(19) Japanese Patent Office (JP)

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(43) Kokai Date: October 7, 1997

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(54) COPPER ALLOY WITH EXCELLENT DISCHARGE ABRASION RESISTANCE

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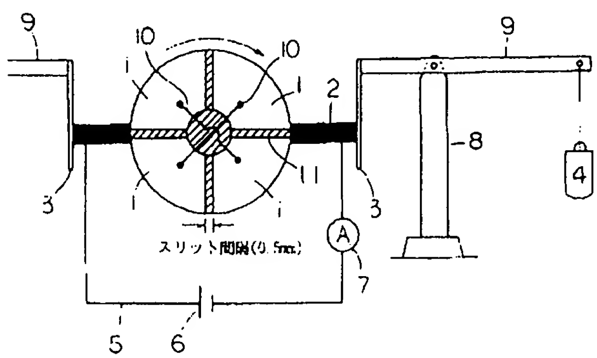
(71) Agent: Kaoru Komoto, Patent Attorney

(57) [Abstract]

[Object] To obtain copper alloys with excellent discharge abrasion resistance.

[Means] A copper alloy containing 0.01 -1.0 wt% Si and further containing a total of 0.01 - 6.0 wt% of one or more of the following: 0.01 - 1.0 wt% Mg, 0.01 – 1.0 wt% Al, 0.01 – 1.0 wt% Ti, 0.01 – 1.0 wt% Cr, 0.01 – 1.0 wt% Mn, 0.01 – 3.0 wt% Fe, 0.01 – 3.0 wt% Co, 0.01 – 4.0 wt% Ni, 0.01 – 5.0 wt% Zn, 0.01 – 1.0 wt% Zr, 0.01 – 1.0 wt% Ag, and 0.01 – 2.0 wt% Sn as needed, with the remainder being copper and unavoidable impurities.



In fig: Slit spacing (0.5 mm)

[Scope of Patent Claim]

[Claim 1]

A copper alloy with excellent discharge abrasion resistance, characterized in that it contains 0.1 – 1.0 wt% Si, with the remainder being copper and unavoidable impurities.

[Claim 2]

A copper alloy containing 0.01 -1.0 wt% Si and further containing a total of 0.01 - 6.0 wt% of one or more of the following: 0.01 - 1.0 wt% Mg, 0.01 – 1.0 wt% Al, 0.01 – 1.0 wt% Ti, 0.01 – 1.5 wt% Cr, 0.01 – 1.0 wt% Mn, 0.01 – 3.0 wt% Fe, 0.01 – 3.0 wt% Co, 0.01 – 4.0 wt% Ni, 0.01 – 5.0 wt% Zn, 0.01 – 1.0 wt% Zr, 0.01 – 1.0 wt% Ag, and 0.01 – 2.0 wt% Sn as needed, with the remainder being copper and unavoidable impurities.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention pertains to copper alloys used in parts that are exposed to discharge abrasion, such as motor switches and various types of contacts, etc.

[0002]

[Prior Art]

Oxygen-free copper, tough-pitch copper, phosphorus-deoxidized copper, silver-added copper, etc., with high conductivity have been used in the past as

the materials for motor switches and contacts. This is because materials with a high conductivity generate little Joule heat at the contact and also have a strong heat-releasing effect and therefore, an increase in the temperature of the contacts can be prevented and the amount of discharge is low. However, there is a demand for switches and various contact parts used in automobiles, etc., with even longer life because of the need for improved reliability. Therefore, the development of a copper alloy with excellent discharge abrasion resistance to replace the above-mentioned pure copper materials has become necessary.

[0003]

[Problems to be solved by the invention]

The present invention is presented in light of the above-mentioned problems of the prior art, its object being to present copper alloys with excellent discharge abrasion resistance.

[0004]

[Means for solving problems]

The copper alloys with excellent discharge abrasion resistance of the present invention are characterized in that they contain 0.1 – 1.0 wt% Si, with the remainder being copper and unavoidable impurities. They further contain a total of 0.01 - 6.0 wt% of one or more of the following: 0.01 - 1.0 wt% Mg, 0.01 – 1.0 wt% Al, 0.01 – 1.0 wt% Ti, 0.01 – 1.5 wt% Cr, 0.01 – 1.0 wt% Mn, 0.01 – 3.0 wt% Fe, 0.01 – 3.0 wt% Co, 0.01 – 4.0 wt% Ni, 0.01 – 5.0 wt% Zn, 0.01 – 1.0 wt% Zr, 0.01 – 1.0 wt% Ag, and 0.01 – 2.0 wt% Sn as needed.

[0005]

The reasons for adding each component of the copper alloys pertaining to the present invention and the reasons for restricting their composition are explained below:

Si: 0.1 = 1.0 wt%

Si is an essential component of the alloys of the present invention. The oxide of Si (SiO_2) produces little free energy and has a high melting point (1,720°C). Therefore, it is stable at high temperatures. It also has a high electrical resistance at high temperatures ($3 \times 10^2\ \Omega \cdot m$ at 1,200°C). On the other hand, it appears that discharge occurs due to interaction between electrons emitted from the material surface and metal vapor during the time when the contacts, which have generated heat with the conduction of electricity, are turned OFF. Alloys containing Si are responsible for rapidly extinguishing discharge during this time because an oxide film is readily produced on the material surface and this oxide surface is stable and has high electrical resistance at high temperatures. The inventors successfully completed the present invention upon discovering that in addition to conductivity, this extinguishing effect is important in parts that undergo discharge abrasion, such as switches and various types of contact parts, etc. This effect will be insignificant if the Si content is less than 0.1 wt%, while if content exceeds 1.0 wt%, this effect will be saturated and there will be a reduction in conductivity and deterioration of hot workability. Consequently, the Si content is set at 0.1 – 1.0 wt%. The particularly preferred range is 0.2 – 0.8 wt%.

[0006]

Mg, Al, Mn, Ag: 0.01 – 1.0 wt% each

Zn: 0.01 – 5.0 wt%

Sn: 0.01 – 2.0 wt%

These elements are added for the purpose of further strengthening the solid solution of the Cu-Si alloy. The most important property of contact materials is discharge abrasion resistance, but the amount of mechanical wear as a result of repeatedly turning the contacts ON and OFF should also be small. Consequently, these elements are added as needed in order to improve abrasion resistance. This effect is minimal when the content of each of these is less than 0.01 wt%. Moreover, if the content of each of these elements exceeds its upper limit, the effect will be saturated, and with the exception of Ag, there will be a marked reduction in conductivity. Furthermore, Ag is expensive and the above-mentioned upper limit was set taking into consideration economic constraints as well. The preferred contents of each are 0.01 – 0.6 wt% Mg, Al, Mn and Ag each, 0.03 – 3.5 wt% Zn, and 0.1 – 1.5 wt% Sn.

[0007]

Ti, Zr: 0.01 – 1.0 wt% each

Cr: 0.01 – 1.5 wt%

Fe, Co: 0.01 – 3.0 wt% each

Ni: 0.01 – 4.0 wt%

These elements form a compound with Si that precipitates and hardens when they are added to Cu-Si alloys. As in the case of the above-mentioned elements, they are added as needed for the purpose of improving abrasion

resistance. This effect will be minimal if the content of each of these is less than 0.01 wt%, while if the content of each of the elements exceeds the upper limit, this effect will be saturated and there will be a marked reduction in conductivity. Consequently, the above-mentioned upper and lower limits were established. The preferred contents are: 0.05 – 1.0 wt% Ti, 0.01 – 0.3 wt% Zr, 0.05 – 1.0 wt% Cr, 0.1 – 2.5 wt% Fe and Co each, and 0.3 – 4 wt% Ni.

[0008]

Furthermore, two or more of the above-mentioned components can be combined and added. If the total amount is less than 0.01 wt%, the effect of improving strength will be insignificant, while if the total amount exceeds 6.0 wt%, there will be a marked reduction in conductivity. Consequently, the total amount when they are added in combination with one another was set at 0.01 – 6.0 wt%. 0.5 – 3% is preferred. The combination of Ti (or Zr, Cr, Fe, Co, Ni) and Mg (or Al, Mn, Ag, Zn, Sn) is given as a preferred combination of auxiliary components.

[0009]

[Examples]

Examples of the present invention will be described below in comparison with comparative examples. Copper alloys with the compositions shown in Table 1 were melted and cast in air and covered with charcoal using a kryptol furnace to obtain ingots that were 50 mm thick, 75 mm wide and 180 mm long. After machining the front and back of these ingots, they were hot-rolled to a thickness of 15 mm at a temperature of 950°C. Then, after removing the oxidation scale with a grinder, they were cold-rolled and annealed for 1 hour at a temperature of

500°C. They were brought to a thickness of 4.0 mm by final cold rolling. The Vickers hardness and the conductivity of the copper alloys of the present invention and comparative alloys are shown in Table 1.

[0010]

[Table 1]

		Chemical components			Conductivity (% IACS)	Vickers hardness (Hv)	Amount of wear (mg)
		Cu	Si	Auxiliary component			
Alloys of the present invention	1	Remainder	0.19	--	57	106	430
	2	"	0.52	--	32	117	360
	3	"	0.91	--	22	129	460
	4	"	0.48	Mg 0.34	26	155	370
	5	"	0.53	Al 0.41	20	161	450
	6	"	0.50	Mn 0.55	21	135	470
	7	"	0.51	Ag 0.10	31	124	310
	8	"	0.47	Zn 2.31	30	127	340
	9	"	0.52	Sn 1.28	21	172	420
	10	"	0.50	Ti 0.86	59	175	330
	11	"	0.53	Zr 0.21	38	145	340
	12	"	0.51	Cr 0.68	40	169	300
	13	"	0.52	Fe 1.49	42	158	320
	14	"	0.49	Co 1.73	51	177	300
	15	"	0.50	Ni 2.25	55	183	280
	16	"	0.54	Ni 2.23 Zn 1.14	53	185	270
	17	"	0.70	Ni 3.2 Mg 0.01 Zn 0.2 Mn 0.03	45	210	245
Comparative alloys	18	"	0.06	--	80	102	590
	19	"	1.13	--	18	133	560
	20	Tough pitch copper (C1100)			100	98	780
	21	Ag-added copper (Cu –0.03 Ag)			99	105	630

[0011]

Next, abrasion tests conducted by rotating specimens while conducting electricity were performed on the copper alloys of the present invention as well as comparative alloys. The tests were performed using the test device shown in

Figure 1 for rotating while conducting electricity. As shown in the figure, Alloy Nos. 1 – 17 of the present invention and Comparative Alloy Nos. 18 – 21 were worked into discs with dimensions of 40 mm ϕ x 4 mm t and divided into 4 equal pieces to obtain test piece 1. These [equal pieces] were placed between insulators 11 to obtain a rotating object with 4 poles. One end of carbon brushes 2 and 2 was brought into contact with the bipolar surfaces of this rotating object and the bottom ends of flat springs 3 and 3 were joined with the other end. One end of pressing tools 9 and 9 were joined with the tops of these flat springs 3 and 3 and weights 4 were connected to the other ends. Furthermore, 10 is a lead wire for conducting electricity that is joined to test piece 1, 5 is a wire that is joined to carbon brushes 2 and 2, 6 is a direct-current power source, 7 is an ammeter, and 8 is the support for the pressing tools.

[0012]

By means of the above-mentioned device, the contact pressure between test piece 1 and carbon brush 2 was adjusted to 435 g/cm^2 using weight 4. Under these conditions, electricity was conducted to test piece 1 at a current density of 0.2 A/mm^2 and the motor was turned at a peripheral speed of 6.3 m/sec (rotational speed: 3,000 rpm) to perform abrasion tests by rotating while conducting electricity. The ambient atmosphere was air at 15°C and the amount of wear of test piece 1 after 400 hours was determined. The results are also shown in Table 1.

[0013]

The alloys of the present invention contain 0.1 – 1.0 wt% Si and have good conductivity and hardness. [Therefore] discharge abrasion resistance is excellent. On the other hand, Comparative Example Alloy No. 18 has a low Si content and therefore, the effect of improving discharge abrasion resistance is insignificant. Furthermore, No. 19 has too high an Si content and therefore, conductivity is reduced and the amount of wear is increased. No. 20 and 21 do not contain Si and therefore, although they have excellent conductivity, the amount of wear is high.

[0014]

[Results of the invention]

As previously explained, the copper alloys of the present invention have low conductivity but excellent discharge abrasion resistance when compared to conventional products. They therefore have a strong effect in terms of improving the life of motor switches and various types of contact parts.

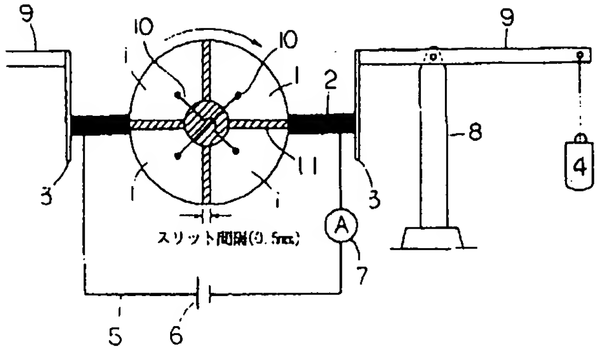
[Brief Description of the Drawings]

[Figure 1] is a side view of the device for testing wear as a result of rotating while conducting electricity in order to investigate discharge abrasion resistance.

[Definition of symbols]

1. Test piece
2. Carbon brush

[Figure 1]



In fig.: Slit spacing (0.5 mm)